Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3430U20-1

Z22-3430U20-1

FRIDAY, 17 JUNE 2022 – AFTERNOON

SCIENCE (Double Award)

Unit 2 – CHEMISTRY 1
FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**11**	
3.	**6**	
4.	**5**	
5.	**6**	
6.	**5**	
7.	**6**	
8.	**9**	
9.	**6**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **7** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

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Answer **all** questions.

1. (a) Rock salt is a mixture of salt and sand. Crystals of pure salt can be obtained from rock salt.

A–E are the steps in the method used but they are in the wrong order.

A Add water to a sample of rock salt in a beaker and stir

B Heat the solution to evaporate some of the water

C Grind the rock salt into a fine powder

D Filter the mixture to separate the sand from the salt solution

E Leave the saturated solution in a warm place for a few days so that crystals of salt form

Put the steps in the correct order. The first step is already included. [2]

C				
first step				

(b) A student was asked to investigate the dyes present in an orange sweet.

The student carried out the following method. There are two errors in the method.

- Draw a line using a ruler and pen on chromatography paper.
- Place a sample of the orange colour on the line.
- Stand the chromatography paper in a beaker and add enough water to just cover the sample.
- Leave the paper to stand until the water rises to the top of the paper.

(i) State the **two** errors in the method. [2]

1. ....

2. ....

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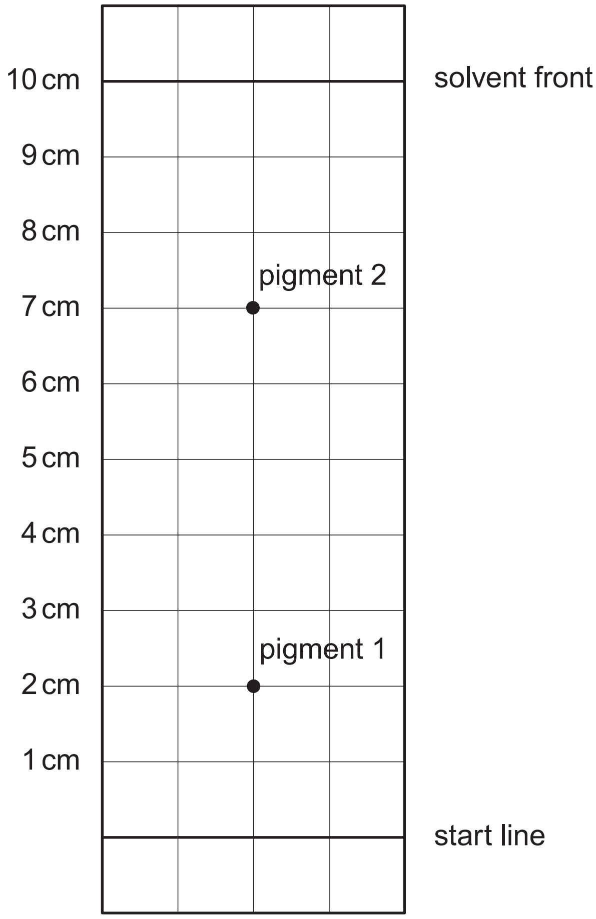
(ii) Another student used a correct method and obtained the chromatogram below.



Use the formula to calculate the R_f value for pigment 2. [2]

$$R_f = \frac{\text{distance travelled by the pigment}}{\text{distance travelled by the solvent front}}$$

R_f = ...

6

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2. A year 10 class investigated the reactions between some metals and hydrochloric acid. Their results are summarised in the table below.

Metal	Initial temperature (°C)	Final temperature (°C)	Rise in temperature (°C)	General observations
zinc	21	32	11	a few bubbles
calcium	22	66	44	lots of bubbles, solution spills out of test tube
magnesium	20		31	lots of bubbles
copper	21	21	0	no bubbles
iron	22	25	3	one or two bubbles

(a) (i) State which metal did **not** react with hydrochloric acid.

Give a reason for your choice. [1]

Metal ....

Reason ....

(ii) Calculate the final temperature for the reaction between magnesium and hydrochloric acid. [1]

Final temperature = ... °C

(b) What name is given to a reaction which gives a rise in temperature? [1]

Choose your answer from the box.

endothermic	**combustion**	**exothermic**	**precipitation**

....

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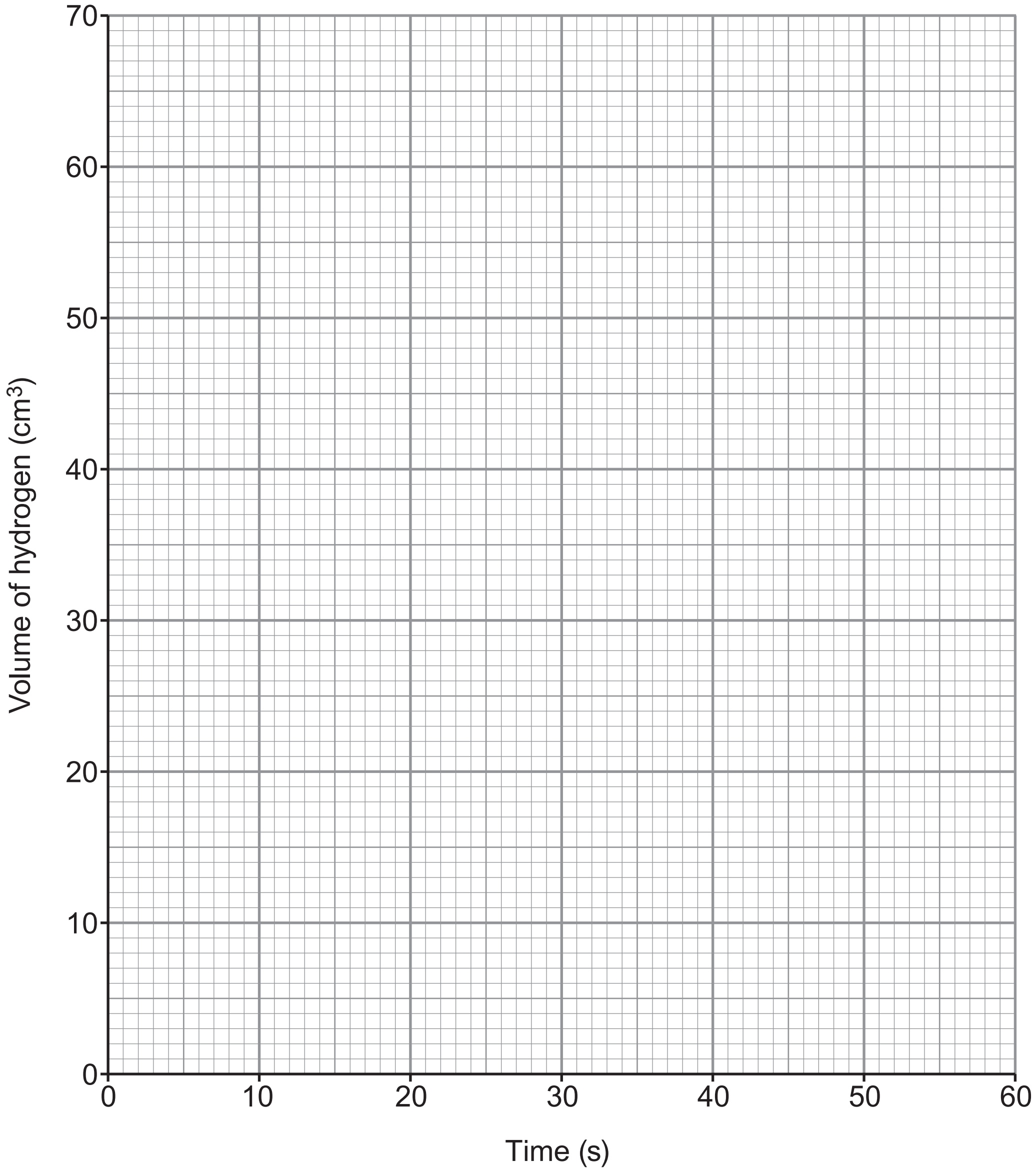
(c) The year 10 class then decided to investigate the rate of the reaction between magnesium and hydrochloric acid.

A piece of magnesium was placed in excess hydrochloric acid at 20 °C. The volume of hydrogen produced was recorded every 10 s.

The results obtained are shown in the table.

Time (s)	0	10	20	30	40	50	60
Volume of hydrogen (cm^3)	0	19	31	40	47	53	56

(i) Plot the volume of hydrogen against time on the grid. Draw a suitable line. [3]



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(ii) The reaction had not finished after 60 s. How does the graph show this?

Put a tick (✓) in the correct box. [1]

- Graph stops at 60 s ☐
- Graph is still rising at 60 s ☐
- Graph reaches a maximum temperature of 56 °C ☐

(iii) Why does the reaction slow down over time?

Put a tick (✓) in the correct box. [1]

- The particles collide with less energy so less chance of successful collisions ☐
- The particles move slower so less chance of successful collisions ☐
- The particles have less surface area so less chance of successful collisions ☐
- The particles get used up so less chance of successful collisions ☐

(iv) Suggest **two** changes you could make to the hydrochloric acid to make the reaction faster. [2]

....

....

(v) In the reaction between magnesium and hydrochloric acid, magnesium chloride is formed. Magnesium chloride contains Mg^{2+} ions and Cl^{-} ions.

Give the formula of magnesium chloride. [1]

....

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3. A beryllium atom can be represented by the following symbol.

$$^{9}_{4}\text{Be}$$

(a) Choose a number from the box to complete each of the following sentences. [4]

4	**5**	**9**	**13**

Each number can be used once, more than once or not at all.

Beryllium has .... protons.

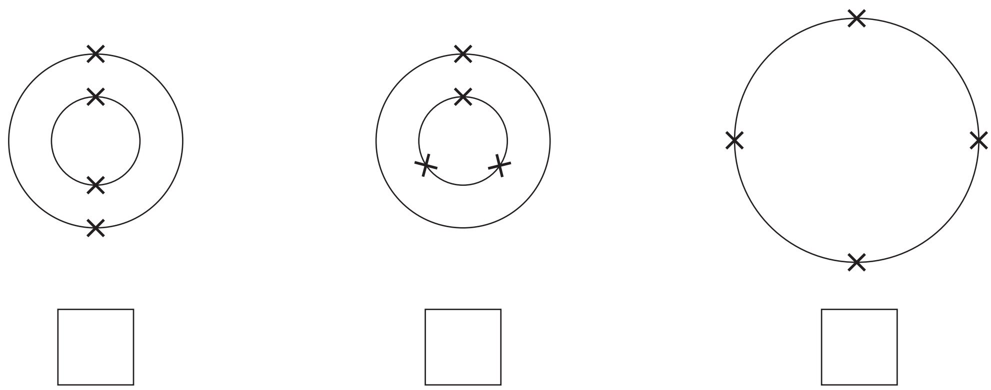
The atomic number of beryllium is ....

The mass number of beryllium is ....

Beryllium has .... neutrons.

(b) Beryllium has 4 electrons.

Put a tick (✓) in the box that shows the correct electronic structure for beryllium. [1]



(c) Beryllium is found in the compound beryllium fluoride, BeF_2.

Give the total number of atoms shown in the formula. [1]

....

6

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4. The table shows various stages in the development of the Earth's atmosphere since its formation 4 500 million years ago.

Stage	Major events	Gases present in the atmosphere
1	volcanic eruptions	carbon dioxide, water vapour, methane, ammonia
2	oceans form	carbon dioxide, methane, ammonia
3	green plants evolve	carbon dioxide, nitrogen, oxygen
4	most carbon dioxide becomes locked in rock and fossil fuels	nitrogen, oxygen, water vapour

(a) Which **one** of these statements best describes how the oceans were formed?

Put a tick (✓) in the box next to the correct answer. [1]

Water vapour evaporated to form clouds ☐

The Earth cooled so water vapour condensed ☐

Bacteria and algae turned the water vapour into liquid water ☐

There were no more volcanoes to produce water vapour ☐

(b) Explain why the appearance of green plants was an important stage in the development of the atmosphere. [2]

....

....

....

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(c) The atmosphere today contains nitrogen, oxygen and water vapour. [1]

Use the following information to identify another gas present.

- a Group 0 gas
- the third most abundant in the atmosphere
- used in light bulbs and as an inert atmosphere for welding

....

(d) Nitrogen can be obtained by heating sodium azide, NaN_3. Sodium is also produced in the reaction.

Complete the balancing of the equation for this reaction. [1]

$$2NaN_3 \longrightarrow 2Na + \boxed{} N_2$$

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5. Drinking water contains a number of ions which are important in the human body. Some of these ions cause hardness in water.

The table shows the concentration of ions in drinking water from four different locations.

Location	Concentration of ions (mg/dm^3 of water)					
	potassium K^+	ammonium NH_4^+	calcium Ca^{2+}	fluoride F^-	sulfate SO_4^{2-}	nitrate NO_3^-
A	0.1	0.4	0.0	0.0	0.4	0.2
B	0.0	0.3	0.4	4.4	0.2	0.0
C	0.2	0.6	2.7	0.4	0.0	0.1
D	3.4	2.1	1.0	2.1	2.5	2.3

(a) Which location is likely to have the hardest water?

Put a tick (✓) in the box next to the correct answer. [1]

A ☐

B ☐

C ☐

D ☐

(b) In which location do people have the least protection against tooth decay from their drinking water?

Put a tick (✓) in the box next to the correct answer. [1]

A ☐

B ☐

C ☐

D ☐

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(c) Ionic compounds dissolve in water to form positive and negative ions.

Which **two** compounds may have dissolved in the drinking water at location **B**?

Put a tick (✓) in the box next to the correct answer. [1]

potassium fluoride and calcium sulfate ☐

ammonium sulfate and potassium nitrate ☐

calcium fluoride and ammonium nitrate ☐

ammonium sulfate and calcium fluoride ☐

(d) (i) Calculate the relative formula mass (M_r) of calcium sulfate, $CaSO_4$. [1]

$A_r(Ca) = 40$ $A_r(S) = 32$ $A_r(O) = 16$

M_r = ...

(ii) Calculate the percentage by mass of fluorine in calcium fluoride, CaF_2. [2]

$M_r(CaF_2) = 78$ $A_r(F) = 19$

Percentage = ... %

6

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6. (a) A technician carried out a flame test and a silver nitrate test on a solution of sodium iodide.

Draw **one** line from **each** test to the correct observation. [2]

Test	**Observation**
	red flame
flame test	yellow flame
	lilac flame
	white precipitate
silver nitrate test	cream precipitate
	yellow precipitate

(b) (i) When silver nitrate and sodium iodide react, sodium nitrate and a precipitate of silver iodide are formed.

Write the formulae of sodium nitrate and silver iodide to complete the equation. [2]

$AgNO_3$ + NaI ⟶ .... + ...

(ii) Suggest a method you could use to remove the precipitate from the reaction mixture. [1]

....

5

Examiner only

7. Describe the advantages and disadvantages of hard water. [6 QER]

6

Examiner only

8. (a) (i) State why sodium is stored in oil in the laboratory. [1]

....

(ii) Describe the change in appearance when a piece of freshly cut sodium is left for a few minutes. [1]

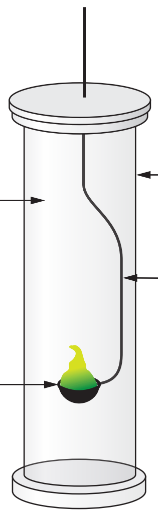
....

....

(iii) Give the formula of the compound formed when sodium reacts with oxygen. [1]

....

(b) The diagram shows the reaction of sodium with chlorine.



(i) State why it is necessary to carry out this reaction in a fume cupboard. [1]

....

(ii) Complete and balance the equation for the reaction of sodium and chlorine. [2]

$\square$ Na + Cl_2 $\longrightarrow$ $\square$ ....

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(c) The table shows some properties of Group 7 elements.

Element	Melting point (°C)	Boiling point (°C)	Reaction with hot iron
fluorine	–220	–188	explosive
chlorine	–101	–34	very fast
bromine	–7	59	quite fast
iodine	114		slow

(i) Put a tick (✓) in the box next to the most likely boiling point for iodine. [1]

–25 °C ☐ 25 °C ☐ 100 °C ☐ 150 °C ☐

(ii) Astatine lies below iodine in Group 7. State how you would expect astatine to react with hot iron.

Give a reason for your answer. [2]

....

....

....

9

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9. (a) In 1915 Alfred Wegener suggested that the Earth's continents were once joined together as one large land mass.

(i) State **three** pieces of evidence that Alfred Wegener used to support his theory. [3]

....

....

....

....

....

....

(ii) Explain why Wegener's theory was not originally accepted by other scientists, but it is today. [2]

....

....

....

....

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(b) What type of destructive event is likely to happen at a **conservative** plate boundary? [1]

....

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END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
aluminium	Al^{3+}	bromide	Br^{-}
ammonium	NH_4^{+}	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^{-}
calcium	Ca^{2+}	fluoride	F^{-}
copper(II)	Cu^{2+}	hydroxide	OH^{-}
hydrogen	H^{+}	iodide	I^{-}
iron(II)	Fe^{2+}	nitrate	NO_3^{-}
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^{+}	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^{+}		
silver	Ag^{+}		
sodium	Na^{+}		
zinc	Zn^{2+}		

THE PERIODIC TABLE

Group

1	2											3	4	5	6	7	0
						1 H Hydrogen 1											4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Key	
A_r	relative atomic mass
Symbol	
Name	
Z	atomic number